Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service ("WCS")	)	GN Docket No. 96-228

REPLY TO OPPOSITIONS OF AMERICAN MOBILE RADIO CORPORATION, DIGITAL SATELLITE BROADCASTING CORPORATION, PRIMOSPHERE LIMITED PARTNERSHIP, AND SATELLITE CD RADIO, INC.

I. INTRODUCTION AND SUMMARY

PACS Providers Forum ("PPF")[1] and DigiVox Corporation ("DigiVox")[2] hereby reply to the Oppositions filed by American Mobile Radio Corporation ("AMRC"), Digital Satellite Broadcasting Corporation ("DSBC"), Primosphere Limited Partnership ("Primosphere") and Satellite CD Radio, Inc. ("CD Radio," and, together with AMRC, DSBC and Primosphere,

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1 PPF is an industry group established in 1995 to promote the development of Personal Access Communications Systems ("PACS"), a low-power, low-cost radio system capable of providing extremely high quality voice and data transmission for both fixed and mobile uses. PPF is a Washington, D.C., non-profit corporation, presently composed of ten member corporations, including Bellcore; Brooktree Corporation; GCI Communications, Inc.; Hughes Network Systems ("HNS"); Matsushita Communication Industrial Corporation of America/Panasonic; Motorola; National Paging and Personal Communications Association; NEC America, Inc.; Newbridge Networks; Pacific Communications Sciences, Inc.; and Siemens Stromberg-Carlson.

2 DigiVox Corporation was established in 1993 as a potential bidder in FCC spectrum auctions. Under its business plan, DigiVox proposes to implement PACS in markets secured by it in the upcoming WCS auction.

the "DARS Applicants") in the above-captioned proceeding. Specifically, PPF and DigiVox reaffirm their conclusion that the out-of-band emission limits on the Wireless Communications Service ("WCS") established in the Commission's Report and Order in this Proceeding (the "Order") impose unnecessary restrictions on the use of that spectrum, limit operational flexibility and thus are contrary to the public interest. As described in greater detail below and based on a thorough technical evaluation of the Oppositions of the DARS Applicants and their proposed operational parameters, nothing in those filings changes our technical conclusion that in the A or B bands of the WCS spectrum, if technical operations conform to the following criteria:

- a 12.5% duty cycle for all portable units, with a 312.5 μsec pulse every 2.5 msec
- the portable units must employ TDMA technology
- Subscriber Unit ("SU") transmit power of 200 milliwatts peak (25 milliwatts average output)
- Radio Port ("RP") transmit power of 800 milliwatts for RP at 25' height (for base stations mounted higher, the power may be raised in accordance with the additional path loss afforded by the greater distance)
- linear polarization
- only fixed (wireless local loop) and portable services may be provided (*i.e.*, no vehicle-mounted units are permitted).

then the following out-of-band emission standards:

- subscriber unit transmit emission levels of 81 + 10 log (P) dB
- base station transmit emission levels of 75 + 10 log (P) dB

will cause no greater interference to the proposed operations of the DARS applicants than the generally applicable out-of-band emission limitations currently provided by the Commission's rules.[3]

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[3] PPF and DigiVox propose that Section 27.53 of the Rules set out in the Order be revised as set forth in Exhibit A hereto.

Accordingly, the Commission should reconsider the out-of-band emission limits contained in the Order and allow for operations that meet the out-of-band emission standards set forth above.

II. BACKGROUND

PPF and DigiVox recognize the significant investment, both domestic and international, that the Commission has made in DARS. The proposal before the Commission would in no way jeopardize the viability of that service. Instead, the limits proposed here constitute a narrow exception to enable PACS, an important, LEC-competitive service, to be provided in the WCS bands. *These limits will provide DARS with a level of protection that is equivalent to that afforded by current rule*, which sets draconian emission limitations in light of the fact that the technical rules for WCS are so liberal. For example, the WCS rules permit unlimited power; the emission limitations we propose would be restricted to operations with a subscriber unit peak power of 200 milliwatts. As set forth in the attached technical appendix,[4] the reduced power, 12.5% duty cycle for the portable units, and other limitations mean that the effect of a PACS handset on a DARS receiver is less than that produced by a single overhanging tree.

In their Oppositions, each of the DARS Applicants has raised technical questions about the Petition for Reconsideration. Engineers working on behalf of PPF and DigiVox, representing many of the world's leading manufacturers of wireless communications equipment, with unsurpassed experience in both the theoretical and implementational aspects of wireless

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4 *See* Exhibit B.

communications technology, have concluded that the concerns raised by the DARS Applicants are unfounded. This conclusion is based on study by PPF's technical staff during the past several months, including their review of the *ex parte* submissions filed by the DARS Applicants in this proceeding.

It is critical to note that the technical objections raised by the DARS Applicants in their Oppositions are general in nature, and do not address the specific features of their service proposals. Based on those Oppositions, as well as a review of the underlying applications of each of the DARS Applicants, it is clear that the technical parameters proposed here will provide adequate protection to DARS.

III. THE TIMING AND NATURE OF THE COMMISSION'S DECISION ARE CRITICAL TO THE SUCCESS OF WCS

As the Commission acknowledged, the out-of-band emission standards adopted in the Order will "make mobile operations in the WCS spectrum technologically infeasible."[5] By so doing, the potential uses of that spectrum and the number of potential bidders in the WCS auction may be significantly reduced, results that are counter to the public interest.

We urge in the strongest possible terms that the Commission clarify in this Order on reconsideration that the relaxed out-of-band emission limitations we propose will be permitted for operations meeting the criteria we identify. Whether such an action is characterized as a waiver or is codified as part of its general rule in the manner proposed herein is of no importance to PPF or DigiVox. What is critical, however, is that the Commission issue a

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5 *See Order* at 3.

formal pronouncement prior to the date of the WCS auction down payment (currently scheduled for April 4).

The suggestion that any relaxation of the rule must be done through waiver at some unspecified later date is simply a ruse to postpone the final determination of this issue until after the auction and thereby preclude additional services from operating in the WCS spectrum. Such a postponement would be damaging for several reasons. First, all of the information necessary for the Commission to reach a final, reasoned decision on this issue is now before the Commission and has been on the record for some time. Similarly, each of the DARS Applicants has had an ample opportunity to review and respond to that information—an opportunity of which they have taken full advantage through their Oppositions and earlier *ex parte* submissions in this proceeding. Second, if the Commission is unwilling to act now, it can only be interpreted by the market as a strong signal that a future waiver for services meeting the PACS standard will not be granted. To avoid this unwanted result, the Commission must make a final determination of this issue before the first payments are due for participation in the auction, as implicitly recognized by the Commission itself in its timetable for this proceeding.

It has also been suggested that one possible solution to this situation is to relegate PACS-like services to secondary status vis-à-vis DARS. This approach would render any service provider that operates under the PACS standard a hostage to the primary service provider. Even with a Commission-imposed requirement of good faith in such negotiations, a significant

subjective element would inevitably remain, leaving open the possibility for extortive behavior by the providers of the primary service.[6]

IV. TECHNICAL ANALYSIS

A. ADEQUATE PROTECTION OF DARS CAN BE ACHIEVED WITHOUT PRECLUDING PORTABLE SERVICE IN THE ADJACENT WCS BANDS

Engineers from Bellcore and HNS have concluded that portable PACS can co-exist with DARS in the WCS bands without consequential interference between the systems if certain emission limits and operational parameters are observed. The engineers have reviewed all of the specific and general arguments raised by the DARS Applicants, and have concluded that operations within the technical parameters originally proposed—with one addition[7]—are indeed sufficient to provide full and reasonable protection to DARS, equivalent to that provided by the general limitations.

In particular, the attached engineering statement finds the following:

- The effect of a PACS handset on a DARS receiver is less than produced by a single overhanging tree.
- It is appropriate to average the power when using a duty cycle for a system that uses TDMA-based portable units.
- 5 dB is the generally recognized standard for signal loss attributable to the human head, taking into account the variability of direction.

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[6] If a service is entitled to interference protection, it is not unreasonable to demand whatever the market will bear to accommodate a secondary service that is requesting a voluntary reduction in that level of protection. One need only be reminded of the difficulties that the Commission has faced with "good faith" bargaining tactics by incumbent microwave operators in the 2 GHz band to understand the potential for abuse that would exist here.

[7] This additional requirement is that portable units must employ TDMA technology.

- Although the low noise floor for DARS systems may rest on unsupportable assumptions, the engineers could make a conservative assumption that would give a 2 dB rise in the DARS noise floor.

- 3 dB is in fact the correct isolation for the respective antennas, even with one antenna being circularly polarized and the other linearly polarized.

- In summation, a PACS portable unit will create a rise of only 6 dB—which the DARS systems should be able to accommodate in any event—in the DARS floor over a 12-foot radius. Beyond that distance, the amount of interference will be so drastically reduced that it will not cause interference to DARS receivers.

- The error correction and interleaving techniques used by all DARS applicants to mitigate highway and foliage obstructions will be sufficient to mitigate the expected PACS interference.

- The 5 Mhz separation is sufficient to protect DARS without the need for specific roll-off requirements.

V. CONCLUSION

PPF and DigiVox strongly support the Commission's implementation of policies that promote spectrum flexibility and market-based determinations as to the best "mix" of WCS services desired by the public. It is critical, however, that this service mix should include low-cost wireless local loop services and innovative complements to emerging PCS systems. PACS and related systems promise to offer fixed or portable services, deployed either as stand-alone systems or as complements to high-tier, high-power CMRS systems, in-building wireless PBX and wireless centrex services. Through these services, PACS will facilitate the rapid deployment of PCS competitors to wireline local loop providers, providing economic and feature-rich services without sacrificing quality, reliability or security. These services will provide consumers with new choices and create new opportunities for emerging businesses operating in the WCS bands.

As noted above, however, the out-of-band emissions limits adopted by the Commission in the Order "will, at least for the foreseeable future, make mobile operations in the WCS spectrum technologically infeasible."[8] PPF and DigiVox therefore urge the Commission to adopt, or reconsideration, the out-of-band emission standards identified above, which are designed to provide DARS with reasonable protection, *fully equivalent* to the standards already in place. By so doing, the Commission can ensure that the spectrum allocated to WCS will support the commercial development of new and complementary PCS offerings, significantly advancing the public interest.

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8 *Order* at ¶ 3.

PPF and DigiVox respectfully request that the Commission reconsider the out-of-band emission limits contained in the Order and adopt the out-of-band emission standards for operations in the WCS bands as provided herein pursuant to the timetable adopted by the Commission in its most recent public notice in the above-captioned proceeding.

Respectfully submitted,

PACS PROVIDERS FORUM

By: John Holland

James F. Rogers
John G. Holland
of LATHAM & WATKINS
1001 Pennsylvania Avenue, N.W.
Suite 1300
Washington, D.C. 20004

DIGIVOX CORPORATION

By: John Prawat /JGH

John Prawat
Chairman and Chief Executive Officer
1250 24th Street, N.W.
Suite 300
Washington, D.C. 20037
(202) 293-1330

March 25, 1997

CERTIFICATE OF SERVICE

I, Wanda J. Sisco, hereby certify that a copy of the foregoing Reply to Oppositions of DigiVox Corporation and the PACS Providers Forum was sent this 25th day of March, 1997, via hand delivery or overnight courier, to the following:

David J. Neff
Vice President, Marketing
ITS Corporation
375 Valley Brook Road
McMurray, PA 15317-3345*

Kathleen Q. Abernathy, Esq.
David A. Gross, Esq.
1818 N. Street, N.W., Suite 800
Washington, D.C. 20036

Glenn S. Rabin, Esq.
ALLTEL Corporate Services, Inc.
655 15th Street, N.W., Suite 220
Washington, D.C. 20005

Lon C. Levin
Vice President
American Mobile Radio Corporation
10802 Parkridge Boulevard
Reston, VA 22091

Christopher D. Imlay, General Counsel
American Radio Relay League, Inc.
Booth Freret Imlay & Tepper, PC
1233 20th Street, N.W.
Suite 204
Washington, D.C. 20036-2304

William K. Keane, Esq.
Arter & Hadden
1801 K Street, N.W.
Suite 400K
Washington, D.C. 20006

Robert J. Miller, Esq.
Gardere & Wynne, LLP
1601 Elm Street, Suite 3000
Dallas, TX 75201*

Lynn R. Charytan
Wilmer, Cutler & Pickering
2445 M Street, N.W.
Washington, D.C. 20037

Wayne V. Black, Esq.
Paula Deza, Esq.
Keller & Heckman, LLP
1001 G Street, N.W., Suite 500 West
Washington, D.C. 20005

John H. Sullivan
Deputy Executive Director
American Water Works Association
Government Affairs Office
1401 New York Avenue, N.W., Ste. 640
Washington, D.C. 20005

---

* Denotes delivery via overnight courier.

Thomas J. Keller, Esq.
Verner Liipfert Bernhard McPherson
& Hand, Chartered
901 15th Street, N.W., Suite 700
Washington, D.C. 20005

Cathleen A. Massey
Douglas I. Brandon
AT&T Wireless Services, Inc.
1150 Connecticut Avenue, N.W
Suite 400
Washington, D.C. 20036

John T. Scott, III, Esq.
Crowell & Moring LLP
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

William B. Barfield, Esq.
Jim O. Llewellyn, Esq.
BellSouth Corporation
1155 Peachtree Street, N.E., Suite 1800
Atlanta, GA 30309-2641*

Michael F. Altschul, Vice President
Randall S. Coleman, Vice President
Cellular Telecommunications Industry
Association
1250 Connecticut Avenue, Ste., 200
Washington, D.C. 20036

George Hanover, Vice President
Joe Peck, Acting Director
Consumer Electronics Mfrs. Assn.
2500 Wilson Boulevard
Arlington, VA 22201

Robert M. Gurss, Esq.
Wilkes Artis Hedrick & Lane, Chartered
1666 K Streeet, N.W.
Suite 1100
Washington, D.C. 20006

Howard J. Symons, Esq.
Sara F. Seidman, Esq.
Gregory R. Firehock, Esq.
Mintz Levin Cohn Ferris Glovsky and Popeo
701 Pennsylvania Avenue, N.W., Suite 900
Washington, D.C. 20004

Louise L. M. Tucker, Esq.
Bell Communications Research, Inc.
2101 L Street, N.W., Suite 600
Washington, D.C. 20037

David G. Frolio, Esq.
David G. Richards, Esq.
BellSouth Corporation
1133 21st Street, N.W.
Washington, D.C. 20036

John Windhauser, Jr.
General Counsel
Competition Policy Institute
1156 15th Street, N.W.
Suite 310
Washington, D.C. 20005

David Alan Nall, Esq.
Squire Sanders & Dempsey
1201 Pennsylvania Avenue, N.W.
Post Office Box 407
Washington, D.C. 20004

Steve C. Hillard
Cook Inlet Communications, Inc.
1966 13th Street
Suite 280
Boulder, CO 80302*

Mark J. Golden
Personal Communications Industry Assoc.
500 Montgomery Street
Suite 700
Alexandria, VA 22314-1561

David L. Hill, Esq.
Audrey P. Rasmussen, Esq.
O'Connor & Hannan, LLP
1919 Pennsylvania Avenue, N.W., Suite 800
Washington, D.C. 20006-3483

Veronica M. Ahern, Esq.
J. Breck Blalock, Esq.
Nixon Hargrave Devans & Doyle
One Thomas Circle
Washington, D.C. 20005

Edwin N. Lavergne, Esq.
J. Thomas Nolan, Esq.
Ginsburg Feldman & Bress
1250 Connecticut Avenue, N.W.
Washington, D.C. 20036

Henry Geller, Esq.
1750 K Street, N.W.
Suite 800
Washington, D.C. 20006

David J. McClure
President
Multipoint Networks
19 David Drive
Belmont, CA 94002-3001*

Diane S. Hinson, Esq.
Cheryl A. Tritt, Esq.
Morrison & Foerster LLP
2000 Pennsylvania Avenue, N.W., Suite 5500
Washington, D.C. 20006-1888

Randall B. Lowe, Esq.
Laura S. Roecklein, Esq.
Piper & Marbury LLP
1200 19th Street, N.W.
Washington, D.C. 20036

Audrey J. Lachance, Esq.
GTE Service Corporation
1850 M Street, N.W.
Suite 1200
Washington, D.C. 20036

Mark E. Crosby, President
Frederick J. Day. Esq.
Industrial Telecommunications Association
1110 N. Gleber Road, Suite 500
Arlington, VA 22201

Theodore M. Weitz, Esq.
Stephen Rosen, Esq.
Lucent Technologies, Inc.
283 King George Road, Room C2A23
Warren, N.J. 07059*

Richard Barth, Director
Stuart Overby, Director
Motorola
1350 Eye Street, N.W., Suite 400
Washington, D.C. 20005

Henry L. Baumann, Executive VP
Valerie Schulte, Esq.
National Association of Broadcasters
1771 N Street, N.W.
Washington, D.C. 20036

Mark J. Tauber, Esq.
Mark J. O'Connor, Esq.
Piper & Marbury , LLP
1200 19th Street, N.W.,
7th Floor
Washington, D.C. 20036

Margaret F. Garber, Esq.
Pacific Telesis Group
1275 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

R. Michael Senkowiski, Esq.
Katherine M. Holden, Esq.
Stephen J. Rosen, Esq.
Wiley Rein & Fielding
1776 K Street, N.W.
Washington, D.C. 20006

Leslie A. Taylor
Guy T. Christiansen
Leslie Taylor Associates
6800 Carlynn Court
Bethesda, MD 208 17-4302

David A. Reams, Esq.
Law Office of David A. Reams
P.O. Box 502
Perrysburg, OH 43552*

Clayton Mowry, Director
Lon Levin, Esq.
Satellite Industry Association
225 Reinkers Land
Suite 600
Alexandria, VA 22314

James P.Tuthill, Esq.
Betsy S.Granger, Esq.
Lucille M. Mates, Esq.
Pacific Telesis Group
140 New Montgomery Street, Room 1526
San Francisco, CA 94105*

Mark J. Golden, Senior VP
Personal Communications Industry Assoc.
500 Montgomery Street
Suite. 700
Alexandria, Virginia 22314-1561

Tina M. Pidgeon, Esq.
Drinker Biddle & Reath
901 15th Street, N.W.
Suite 900
Washington, D.C. 20005

Caressa D. Bennet, Esq.
Gregory W. Whiteaker, Esq.
Bennet & Bennet, PLLC
1019 Nineteenth Street, N.W., Suite 500
Washington, D.C. 20009

James D. Ellis, Esq.
Robert M. Lynch, Esq.
David F. Brown, Esq.
SBC Communications, Inc.
175 E. Houston, Room, 1254
San Antonio, TX 78205*

Duward D. Dupre, Esq.
Mary W. Marks, Esq.
Southwestern Bell Telephone Company
One Bell Center, Room 3558
St. Louis, MO 63101*

Carol Tacker, Esq.
Bruce Beard, Esq.
Southwestern Bell Mobile Systems
17330 Preston Road, Suite 100A
Dallas, TX 75252*

Jonathan M. Chambers, Esq.
Sprint Spectrum, LP
1801 K Street, N.W. Suite M-112
Washington, D.C. 20006

James A. Casey, Esq.
Morrison & Foerster LLP
2000 Pennsylvania Avenue, N.W., Ste. 5500
Washington, D.C. 20006

George Y. Wheeler, Esq.
Koteen & Naftalin LLP
1150 Connecticut Avenue, N.W.
Washington, D.C. 20036

Robert A. Hart IV, Chairman
21st Century Telesis, Inc.
P.O. Box 66436
Baton Rouge, LA 70896*

Paul C. Besozzi, Esq.
Janet Fitzpatrick, Esq.
Patton Boggs, LLP
2550 M Street, N.W.
Washington, D.C. 20037

Leonard R. Raish
Fletcher, Heald & Hildreth, P.L.C.
11th Floor
1300 North 17th Street
Rosslyn, VA 22209

Jay C. Keithley, Esq.
Sprint Corporation
1850 M Street, N.W., Suite 1100
Washington, D.C. 20036

Dr. Eric Schmidt
Sun Microsystems Laboratories
2550 Garcia Avenue
Mountain View, CA 94043-1100*

Jeffrey L. Sheldon, General Counsel
Sean A. Stokes, Assoc. General Counsel
UTC
1140 Connecticut Avenue, N.W., Ste. 1140
Washington, D.C. 20036

Joe B. Wyatt, Chancellor
Vanderbilt University
211 Kirkland Hall
Nashville, TN 37240*

International Transcription Service
1919 M Street, N.W.
Room 146
Washington, D.C. 20036

Cathleen A. Massey
Vice President - External Affairs
AT&T Wireless Services, Inc.
1150 Connecticut Avenue, N.W., Suite 400
Washington, D.C. 20036

Mark J. O'Connor
Piper & Marbury, L.L.P.
1200 19th Street, N.W., Seventh Floor
Washington, D.C. 20036

John T. Scott, III
Crowell & Moring, LLP
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

Henry Geller
1750 K Street, N.W.
Suite 800
Washington, D.C. 20006

Stuart Overby, Asst. Dir., Spectrum Planning
Motorola
1350 Eye Street, N.W.
Washington, D.C. 20005

David J. McClure
President and CEO
Multipoint Networks, Inc.
19 Davis Drive
Belmont, CA 94002-3001*

Diane S. Hinson
Morrison & Forester LLP
2000 Pennsylvania Avenue, N.W.
Suite 5500
Washington, D.C. 20006

George Hanover
Vice President, Engineering
Consumer Electronics Manufacturers Assoc.
2500 Wilson Boulevard
Arlington, VA 22201

Kathleen Q. Abernathy
AirTouch Communications, Inc.
1818 N Street, N.W.
Suite 800
Washington, D.C. 20036

Mark E.Crosby
President and CEO
Industrial Telecommunications Assoc., Inc.
1110 N. Glebe Road, Suite 500
Arlington, VA 22201

William L. Roughton, Jr.
Associate General Counsel
PrimeCo Personal Communications, L.P.
1133 20th Street, N.W., Suite 850
Washington, D.C. 20036

Lynn R. Charytan
Wilmer, Cutler & Pickering
2445 M Street, N.W.
Washington, D.C. 20037

Steve C. Hillard
Cook Intel Region, Inc.
1966 13th Street, Suite 280
Boulder, CO 80302*

Louise L.M. Tucker
2101 L Street, N.W., Suite 600
Washington, D.C. 20037

Henry L. Baumann
National Assocation of Broadcasters
1771 N Street, N.W.
Washington, D.C. 20036

Jeffrey L. Sheldon
General Counsel
UTC, The Telecommuncations Assoc.
1140 Connecticut Avenue, N.W., Ste. 1141
Washington, D.C. 20036

Ronald J. Binz
Competition Policy Institute
1156 15th Street, N.W.
Suite 310
Washington, D.C. 20005

John H. Sullivan
Deputy Executive Director
American Water Works Association
Government Affairs Office
1401 New York Avenue, N.W., Suite 640
Washington, D.C. 20005

ITS
2100 M Street, N.W.
Suite 140
Washington, D.C. 20037

Dennis Couillard
Wayne Leland
Eric Schimmel
TIA
2300 Wilson Blvd., #300
Arlington, VA 22201

William B. Barfield
Jim O. Llewellyn
BellSouth Corporation
1155 Peachtree St., NE, Ste. 1800
Atlanta, GA 30309-2641*

Leonard Robert Raish
Fletcher, Heald & Hildreth, PLC
1300 North 17th Street, 11th Floor
Rosslyn, VA 22209

Gina Harrison, Director
Pacific Telesis Group
1275 Pennsylvania Ave., N.W.
Suite 400
Washington, D.C. 20004

George Y. Wheeler
Koteen & Naftalin, L.L.P.
1150 Connecticut Avenue, N.W., Ste. 1000
Washington, D.C. 20036

Wayne V. Black
Brian Turner Ashby
Keller & Heckman LLP
1001 G Street, N.W.
Suite 500 West
Washington, D.C. 20001

Cheryl A. Tritt
Morrison & Forester, LLP
2000 Pennsylvania Ave., N.W., Ste. 5500
Washington, D.C. 20006

Leslie A. Taylor
Guy T. Christiansen
Primosphere Limited Partnership
6800 Carlynn Court
Bethesda, MD 20817-4302

Laura S. Roecklein
Piper & Marbury, L.L.P.
1200 19th St., N.W.
Washington, D.C. 20036

David F. Brown
SBC Communications, Inc.
175 E. Houston, Room 1254
San Antonio, TX 78205*

Commissioner James H. Quello
Federal Communications Commission
1919 M Street, N.W., Room 802
Washington, D.C. 20554

Chairman Reed E. Hundt
Federal Communications Commission
1919 M Street, N.W., Room 814
Washington, D.C. 20554

Commissioner Rachelle B. Chong
Federal Communications Commission
1919 M Street, N.W., Room 844
Washington, D.C. 20554

Rudolfo M. Baca
Office of Commissioner Quello
Federal Communications Commission
1919 M Street, N.W., Room 802
Washington, D.C. 20554

Suzanne Toller
Office of Commissioner Chong
Federal Communications Commission
1919 M Street, N.W., Room 844
Washington, D.C. 20554

Michelle Farquhar
Wireless Telecommunications Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

Kathleen Ham
Wireless Telecommunications Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

Jonathan J. Cohen
Wireless Telecommunications Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

Commissioner Susan Ness
Federal Communications Commission
1919 M Street, N.W., Room 832
Washington, D.C. 20554

Julius Genachowski
Chief Counsel, Office of Chairman Hundt
Federal Communications Commission
1919 M Street, N.W., Room 814
Washington, D.C. 20554

David Sidall
Office of Commissioner Ness
Federal Communications Commission
1919 M Street, N.W., Room 832
Washington, D.C. 20554

Dan Phythyon
Wireless Telecommunications Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

Tom Stanley
Wireless Telecommunications Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

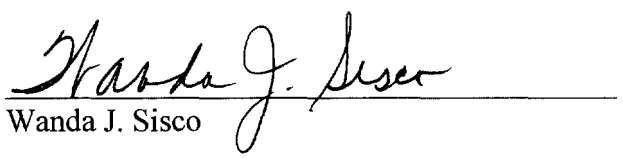
Ruth Milkman
International Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

Bruce Franca
Office of Engineering and Technology
Federal Communications Commission
2025 M Street, N.W.
Washington, D.C.

Steve Sharkey
International Bureau
Federal Communications Commission
1919 M Street, N.W
Washington, D.C. 20554

Tom Mooring
Federal Communications Commission
2025 M Street, N.W.
Washington, D.C.

Charles Iseman
Office of Engineering and Technology
Federal Communications Commission
2025 M Street, N.W.
Washington, D.C.



Wanda J. Sisco

A

EXHIBIT A

Section 27.53 of the Rules is hereby revised to add a new subsection (10), as follows:

(10) Notwithstanding Subparagraphs (1), (2) and (3) above, any operations which meet the following criteria:

i. 12.5% duty cycle for all portable units, with a 312.5 μsec pulse every 2.5 msec;

ii. The portable units must employ TDMA technology;

ii. Subscriber unit transmit power of 200 milliwatts peak (25 milliwatts average output);

iii. Radio port transmit power of 800 milliwatts for RP at 25' height (for base stations mounted higher, the power may be increased in accordance with the additional path loss afforded by the greater distance);

iv. Linear polarization; and

v. Only fixed (wireless local loop) and portable services may be provided (*i.e.,* no vehicle-mounted units are permitted)

shall not be subject to the limitations of Subparagraphs (1), (2) and (3) hereof, but shall be subject to the following limitations:

i. Subscriber unit transmit emission levels of 81 + 10 log (P) dB; and

ii. Base station transmit emission levels of 75 + 10 log (P) dB

(*Optional phrase*: except pursuant to subsection 9 hereof or upon a general waiver by the Commission)

B

EXHIBIT B

Bellcore
Bell Communications Research

March 25, 1997

Technical Analysis of SDARS Comments in GN Docket N. 96-228

H. W. Arnold, Ph.D., Bellcore
S. Baer, Bellcore
H. Sherry, Ph.D., Bellcore
P. Zablocky, Ph.D., Bellcore
R. White, Ph.D., Bellcore

S. Kay, Ph.D. Hughes Network Systems

Bellcore and Hughes Network Systems have analyzed the comments filed by the four SDARS applicants. The technical concerns raised in these filings were classified into four areas, which are addressed below.

In summay we find that none of the commentors raised any technical issues that would imply that a PACS system operation in the WCS bands will cause undue interference to SDARS operation in the 2325-2350 MHz.

Specific conclusions are:

1. **Duty Cycle**: The PACS duty cycle produces very low interference that can be easily mitigated with the proposed SDARS technology.
2. **Link Budget**: The effect to a SDARS receiver of a PACS handset is less than that produced by a single overhanging tree.
3. **Guard Bands**: Out of band noise generated by the PACS portables will be below the level to cause undue interference to SDARS
4. **Noise and Path Blockage**: Noise and Path Blockage are highly dependent on the operating environment; techniques used by SDARS to accommodate these variations in environment will also accommodate the small added interference from PACS portables.

The PACS duty cycle produces very low interference that can be easily mitigated with the proposed SDARS technology.

Opposition to the Petition for Expedited Reconsideration make two duty cycle related claims.

(1) Primosphere and DSBC state that duty cycle related benefits only accrue to systems employing pulse transmission. This may be true. This is an advantage of the TDMA based portable units proposed by PFF/Digivox. We propose that the Commission require the use of TDMA technology for portable units as one of the criteria to be met to qualify for relaxed out of band emission limits.

(2) AMRC, DSBC and Primosphere raise concerns that use of duty cycle / pulsed based transmission may still cause harmful effects. The technical argument below illustrates that fade mitigation procedures built into proposed SDARS systems contain mechanisms to adequately deal with potential interference caused by PACS subscriber units.

The SDARS applicants' systems[1][2][3][4][5] all use forward error correction and frame interleaving techniques to effectively mitigate the adverse effects of signal loss from fades introduced by obstructions such as buildings, highway overpasses, bridges and trees. If a PACS subscriber unit was in extremely close proximity to the SDARS receiver so as to produce interference, the minimal interference produced by the low-duty cycle TDMA structure of the PACS transmission could be easily mitigated by existing mechanisms that SDARS must use to deal with these fades.

For example, Primoshpere indicates that outage-level fades lasting more than 3 seconds occur only about 2% of the time[6]. Short duration fades can be effectively mitigated by advanced coding and time interleaving techniques". This leads us to conclude from this that Primoshpere will use coding and interleaving adequate to protect against fades of 3 seconds duration. It should be clear to those versed in the art of error correcting coding, that the interleaver will need to be roughly an order of magnitude longer that the expected outage event. So the interleaver itself will span approximately 30 seconds. One may quibble over the details but clearly the interleaver will be much longer than the 312 usec burst from the PACS handset. This clearly invalidates Primoshpere's conclusion that the burst interference from PACS would "be heard by every SDARS user as a very annoying interruption at a 400 Hz rate."

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[1] SATELLITE CD RADIO, INC, Supplement to Petition for Rulemaking, May 18, 1990, RM-7400
[2] SATELLITE CD RADIO, INC, Amendment to Satellite Systems Proposal and Applications to Construct, Launch and Operate Space Stations in the Satellite Sound Broadcasting Service at 103° West Longitude, August 3, 1990, File No. 59-DSS-AMEND-90
[3] Digital Satellite Broadcasting Corporation, "Application of Digital Satellite Broadcasting Corporation for a Digital Audio Radio Service Satellite System", Dec 15, 1992, File No. 12/13-DSS-P-93
[4] American Mobile Radio Corporation, "Applications for Authority to Construct, Launch and Operate a Domestic Communications Satellite System for the Provision of Digital Audio Radio Service", File Number 10/11-DSS-P-93, Dec 21, 1992
[5] Primosphere Application, File Nos. 29/30-DSS-LA-93 and 16/17-DSS-P-P, Dec 15, 1992
[6] Primosphere Opposition to Petition for Expedited Reconsideration

The question now centers on the ability of the error correcting codes to deal with an error rate of 1/16, i.e., PACS transmission causing 1/8 of the bits to be received randomly as ones or zeros. Certainly there are codes whose capabilities exceed this. For example, the well known and simple Golay code corrects 3 errors in 24 bits which is twice the error correcting capacity required.

Primoshpere claims to demonstrate "the fallacy of DigiVox's argument, if the PCS peak (hence average) power was increased by 20-30 dB, in the real world, there would be no change in the number of bits that were affected since they had already been destroyed at the lower power level. Increasing the average power level will not affect performance hence the number of bits corrupted during the period that the pulse is at its peak level. " This, in fact is exactly correct. In stating this as the "fallacy" Primoshpere completely misses the point that the error correcting codes and interleaving perform identically whether a bit has been destroyed by 5 dB or 50 dB of interference.

The effect to a SDARS receiver of a PACS handset is less than that produced by a single overhanging tree.

Any wireless system providing coverage to mobile users must reckon with the statistical character of the radio propagation path. Satellite-based systems such as SDARS are no exception. By their own recognition, they employ mitigation techniques such as interleaving and error correction coding to deal with impairments such as multipath and signal blockage from trees, buildings, etc. Commentors, must notably Primosphere, however, have attempted to apply worst-case principles to the analysis of potential interference from the WCS band into the SDARS band. Because of the ability of well-designed SDARS systems to mitigate statistical propagation impairments, a statistical view of potential interference is also appropriate, and will be outlined here. The starting point for this discussion is the February 5, 1997 Letter from Stan Kay of HNS and the Primosphere Opposition filed March 21, 1997.

Arguments made here in previous sections justify that mitigation techniques which must be employed by SDARS systems are also equally effective at "averaging" the effect of transmissions from pulsed (TDMA) systems operating in the WCS band. It is thus appropriate to use average WCS transmission power when computing potential interference into SDARS. In short, the 9 dB of isolation (relative to peak WCS power) enumerated by DigiVox is appropriate.

Primosphere and others correctly point out that absorption of energy from handheld WCS transmitters by the human head is statistical in nature. At an extreme, the presence of the human head may create a small amount of apparent gain in some directions. Extensive measurements by the cellular and PCS community, however, demonstrate that on average the human head creates several dB of additional loss. The 5 dB used is a value used in